

actually in attendance. A few figures respecting some of these schools will show how these institutions stand in public opinion. The Munich Technical High School cost 157,000*l.*, the apparatus alone being worth 36,000*l.*, and the annual expenses amounting to 20,000*l.* The Zürich Polytechnic spends 20,000*l.* annually, 13,800*l.* being derived from Federal taxes, and 3794*l.* only from fees. There are forty-five professors on the lecturing staff. 50,000*l.* have just been spent on laboratory extension. The Stuttgart Polytechnic has a State subvention of 12,000*l.*, that of Dresden 12,200*l.* The Hanover Polytechnic cost 350,000*l.*; its collection of models (chiefly engineering), 36,000*l.*, and 1250*l.* is spent every year in adding to the collection. Some idea of the preparation made for teaching engineering students may be gathered from the fact that there are stated to be in this one school no fewer than 673 tables for drawing. The Berlin Polytechnic, now nearly completed, has cost 450,000*l.*; that of Moscow 496,000*l.* The chemical laboratory of the Polytechnic of Aachen alone cost 45,000*l.* The Bernoullianum of Berne cost that little town more than 1*l.* per inhabitant! At such a price do our neighbours provide for the higher technical training. In France, too, the technical schools are maintained at great cost. In the École Polytechnique, salaries alone amount to 22,000*l.* per annum. A new addition to the laboratories is costing 96,000*l.* All this is found by the Government. On the other hand the École Centrale, which spends 17,836*l.* per annum, is self-supporting, the fees being very high.

From this enormous expenditure of money on Higher Technical Education, tangible results cannot but accrue. Many such are mentioned in the pages of the Commissioners' Report. They adduce examples of improvements in machinery which are the result to a large extent of students' training. They point out how in Continental chemical works and dye works there is a thoroughly trained chemist at the head of each separate department. They indorse the opinion of Prof. von Helmholtz as to the absolute economy of employing as heads of departments persons conversant with the theory of their work, and able by virtue of their scientific knowledge to anticipate results and to make quantitative calculations. They remark that in physics, as also in chemistry, the knowledge of the principles of the science and of the methods of research is the more important part of the equipment of the technical student. They ascribe the general diffusion of high scientific knowledge in Germany to the multiplication of the Polytechnics, and to the small cost of a higher or University education. Amongst the opinions, which they quote, of authoritative speakers, there is one of particular appositiveness from the mouth of Prof. Quincke. He holds that it is an error to suppose that any Polytechnic course of instruction can *by itself* teach a student to erect an engine, work a blast-furnace, or manufacture sulphuric acid: he holds that lectures and laboratory work are obviously insufficient to prepare the student for carrying on work where actual practical experience is needed; but that, in contradistinction, the object of the Polytechnic School is to *facilitate the transition from pure science to practice*. The functions of the Polytechnic have probably never before been so well defined. It may be an open question what kind of training is the best to qualify a man to be manager of an in-

dustrial concern. But there can be no question whatever of the consensus of opinion on the Continent as to the value of the Polytechnic training. It may not, nay, cannot, supplant the experience of the workshop: but it gives something that no amount of mere workshop experience can give—something which, were it suitably introduced into industrial Britain, would supply the greatest industrial want of our time.

BRITISH MINING

British Mining, a Treatise on the History, Discovery, Practical Development, and Future Prospects of Metalliferous Mines in the United Kingdom. By Robert Hunt, F.R.S. 4to. Pp. xx. 944, 231 Woodcuts and 2 Folding Plates. (London: Crosby Lockwood and Co., 1884.)

THE title shows that the author's object is to describe the past and present condition of British metal mines, and to venture some prophecies as to their future. It requires a bold heart to attempt a work of this kind; but, as explained in the preface, Mr. Hunt's long connection with mines and his official position as Keeper of Mining Records have given him excellent opportunities for gathering information.

The work is divided into four books. Book I. gives a long historical sketch of British metal mining from the time of the Phœnicians downwards. With reference to St. Michael's Mount being their trading station, the author indorses the old Cornish tradition and disagrees (p. 845) with Prof. Rhys, who has suggested that the Isle of Thanet was the *Iktis* of Diodorus. From detached memoirs and reports much information has been collated concerning mining work carried on by the Romans for lead, iron, copper, and gold.

In Chapter III., upon mining to the eighteenth century, Mr. Hunt fixes very exactly the date of the introduction of gunpowder for blasting in Cornish mines. Chapters IV., V., and VI., relating to the mining of tin, copper, lead, silver, iron, and zinc to the end of the eighteenth century, are full of valuable facts, and both here and in Chapter III. we notice many interesting statements concerning the special privileges of miners and the charters granted to them.

Book II., occupying one-third of the volume, is devoted to the formation of metalliferous deposits. The rocks and mineral veins of the principal mining districts are described, and long quotations are made from sundry writers. Mr. Hunt then sets forth the hypotheses of the best-known authors concerning the origin of lodes, and very wisely does not bind himself to any particular theory; he admits that mineral veins have been formed by deposition in fissures from lateral infiltration, from surface-water carrying down soluble salts they have dissolved out in their passage, and lastly, from ascending mineral springs. He further considers that many of the conditions observed are due to electro-chemical influences.

In the last chapter of this book the author brings forward instances of remarkable tin, lead, and copper mines in Cornwall, Wales, Ireland, and the North of England.

Book III., which is of the same length as the preceding one, is a treatise on practical mining. Rock-boring by machinery very properly comes in for a large share of attention, but some other departments of mining are

treated rather cursorily. In speaking of the *man-engine* for raising and lowering men, Mr. Hunt points out that the reason why this valuable invention is so little used is "the unfortunate system under which the mines of Cornwall and Devon are worked—a system which does not encourage the holder of shares to take any interest in the mines themselves, his interest being confined to the market value of the shares which he holds." This remark is unhappily applicable to other districts.

In Chapter IV., on ore-dressing, after an historical sketch, the principles of the mechanical preparation of ores for the smelter and the various kinds of machines now in use are described with the aid of numerous illustrations.

Chapter V., upon the discovery and extraction of iron ores from veins and other deposits, is disappointing, on account of its meagreness compared with the space devoted to less important metals, and the Cleveland ore should scarcely have been dismissed in a dozen lines.

Book IV. relates to the future prospects of British mining. To persons interested in mines, whether as owners, shareholders, workmen, or merchants furnishing them with supplies, this book will no doubt seem the most important in the volume. Mr. Hunt is not sanguine about better prices for tin, and he says that "it is improbable that our native copper mines can be expected to prove profitable for some time to come"; in the case of lead he evidently is not more hopeful, and though the prospects as regards zinc are brighter, still we are unable to supply our own wants. In spite of the productiveness of our iron mines, we have to import more than three million tons of iron ore annually.

The fourth chapter of this book contains numerous useful suggestions for working mines, and is well worthy of consideration by miners and shareholders in mines. With reference to profitable mining, Mr. Hunt says (p. 868):—"The question is frequently asked, Is British mining a remunerative pursuit? Various replies might doubtless be given in accordance with any particular set of views and opinions held on the subject, but mines promoted by mere speculation can scarcely be expected to become profitable, inasmuch as they are too frequently grounded upon a misrepresentation of facts, while the capital connected with them is often largely diverted to the pockets of individuals whose main purpose is immediate gain. Further, the management or conduct of affairs is often leavened with ignorance and incompetency; the acquisition of personal gain, at the cost of unsuspecting shareholders, being unfortunately sometimes the rule of action." No one who knows anything about mining can fail to indorse these remarks.

In Chapter V., which contains the general summary and conclusion, Mr. Hunt says that "the exhaustion of our mineral wealth is now going onward at a rapidly increasing rate," and the question arises whether we can meet the demands of trade from British mines or not. According to the author, our tin ore is practically inexhaustible, but for copper, lead, zinc, and silver we must depend greatly upon foreign and colonial mines; of iron ore we have enough for some years, though certain foreign ores are of importance to us.

The situation is summed up as follows:—"Without great improvements in the principles of mining it will not

be possible to work, at a profit, many of our deeper and more extensive mines."

The last two pages of the work, before the appendix, contain several important maxims which deserve the careful study of all persons engaged in mines, such as the necessity of supplying pure air *at any cost*, of raising and lowering the men by machinery, and providing for them in the event of accident or disease. The concluding words very properly strike at the rascality which has done much to wreck British metal mining. "Beyond these, to enable the adventurers in our Home Mines to compete satisfactorily in the metal markets with the proprietors of colonial and foreign mines, and to realise a profit on the sale of their minerals, it is absolutely necessary to study the strictest economy, and to establish—beyond the risk of any failure—the highest principles of honesty in every department, directly or indirectly, connected with British Mining."

The size of Mr. Hunt's volume is apt to alarm the reader, and the publishers would probably have done better by issuing the work in separate books. It strikes us, too, that undue prominence is given to tin, to the detriment of the more important metal iron. From the "Mineral Statistics" for 1883, we see that the iron ore raised had a value of about 5½ millions sterling, whereas the value of all the other metalliferous ores put together was only 1½ million. However, in spite of this favour shown to tin and of occasional inaccuracies, Mr. Hunt's *magnum opus* is very praiseworthy, as it contains a vast store of useful information, and the antiquary, the miner, and the capitalist are greatly indebted to him for having taken the trouble to chronicle so many valuable facts relating to such an important branch of British industry as Metal Mining.

LETTERS TO THE EDITOR

- [The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]
- [The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

The International Geological Congress

WILL you allow me to announce in your columns that, in consequence of the outbreak of cholera in the South of Europe, the International Geological Congress is postponed to September 1885.

JOHN MCKENNY HUGHES

Woodwardian Museum, Cambridge, August 12

The Volcanic Dust Phenomena

I WOULD draw the attention of such of your readers as may be travelling in Switzerland or other mountainous countries to the circumstance that in the clear atmosphere of the mountains the great corona or circle round the sun, as well as the semicircle seen opposite the sun before and after sunset continue to be markedly conspicuous; and the higher one ascends the more striking these phenomena are. I saw both the phenomena especially remarkable on the Gornergrat, altitude 10,289 feet, on the 21st and 22nd of last month; and even as low as 4000 feet they are decidedly more striking than at sea-level. It appears, therefore, that the bulk of the volcanic dust, if such it be, that still remains continues at a great elevation, and the prediction made last autumn that it might remain for years in the atmosphere, seems likely to be fulfilled.

The explanation of the strange sunsets given by "F. A. R. R." in NATURE (p. 155), seems a good one, except as regards the green appearance of the moon and stars; I must confess I am